

## Do Multi-planet Extrasolar Systems Contain Terrestrial Planets?

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About 50% of extrasolar systems with only one planet have trends in the residuals to radial velocity fits. This strongly argues that such systems contain additional planets. Likewise, it is possible that such systems may also harbor additional (low-mass) companions. Therefore, it is necessary to conduct studies which look for regions in extrasolar planetary systems where such low-mass companions can have long-term stable orbits. Since terrestrial planets are of order 100 to 1000 times less massive than jovian planets, it is appropriate to approximate such small bodies with (massless) test particles. In this work, we present the results of an extensive study of the stability of test particles in the four extrasolar planetary systems, Upsilon Andromedae, GJ 876, 47 Uma, and 55 Cancri. These systems are particularly interesting since they have planets in or near resonances. We explore the possibility that these extrasolar planetary systems may contain additional planets with masses of order that of Earth. All the extrasolar planetary systems around main sequence and subgiant stars have been detected with the precision radial velocity technique. This method, which favors the detection of close-in giant planets, is currently unable to detect terrestrial planets or distant gas giants. Although continued observations should help with this insensitivity, some of the distant gas giants, as well as terrestrial planets, are more amenable to detection with other techniques and future space-based missions, such as Darwin, COROT, Kepler, SIM, and TPF.

